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Editorial commentary

Research on the mesenchymal stem cells in the maxillo-facial region and bone tissue regeneration

Bone loss in the maxillo-facial region is a major health care concern. Maintaining the integrity of the bone structure around the teeth or dental implants is crucial for preserving oral function. Alveolar cleft repairs and maxillary defect reconstruction after tumor surgeries are also challenging requirements, as they need to be designed to meet specific needs and demands for optimizing functional and cosmetic outcomes. Autologous bone grafts have long been considered the first choice for the repair of bone defects. This is a standard treatment widely used for maxillo-facial skeletal defects and deformities. However, the volume of the bone graft harvest is restricted because of additional surgery and donor site functional impairment. Bone tissues of allogeneic, xenogeneic, or synthetic substitutes occasionally have limitations of insufficient bone graft volume as well as risks of immune rejection or contagious diseases. Recently, bone tissue regeneration has been progressively achieved by the application of tissue engineering, in which cells and growth factors are combined with biocompatible scaffolds, providing a promising approach for improved clinical application. Therefore, selection of highly osteogenic cells is very important to achieve effective treatment.

In this issue, Dr. Yamachika and Dr. Iida review the available evidence on the use of mesenchymal stem cells (MSCs) for bone regeneration (page 35) [1]. They summarize the immunophenotype of the MSCs reported in the literature and provide results of their mice experiments. The sources of adult MSCs and their suitability for bone regeneration applications are discussed in this review and a newly developed approach using mice compact bone-derived MSCs is introduced. They describe the use of serum-free medium for *ex vivo* isolation and expansion of MSCs. Tumor formation by MSCs is also discussed. This review greatly helps scientists to comprehend the current progress and advantages of using mesenchymal cells, and the limitations of animal models for conducting bone tissue engineering research.

Significant research efforts have been undertaken in the last decade to develop specific cell-based therapies. The review by Arvidson et al. [2] highlights the research areas of central importance in orthopedic and maxillofacial bone tissue repair, including normal fracture healing, biomaterial scaffolds for tissue engineering, and mesenchymal and fetal stem cells. In this detailed review, the basic science and recent advances related to MSCs and osteogenesis are discussed [2]. Multipotent MSCs hold great promise for skeletal regenerative strategies. However, clinical translation of the therapies has not been firmly established [3]. Steinert et al., in their review on MSCs, describe that, relatively, only a few cell-based approaches have been applied at the clinical level, and until date, none of these treatments has become a ''standard-of-care'' treatment for an orthopedic disease. They have discussed the multifaceted reasons for the current status, from the medical, research, and regulatory perspectives [3].The most recent strategy for bone tissue engineering is the use of induced pluripotent stem cells (iPSCs) [4]. iPSCs application was investigated in periodontal tissue regeneration including alveolar bone formation [5].

Khojaseh and coworkers have reviewed studies published in English language that applied MSCs as a part of the treatment protocol for the reconstruction of bone defects in rat, rabbit, dog, and human models [6]. Sources of stem cells, experimental animals and subjects, sites and sizes of defects, carriers and constructs, use of additional growth factors, parameters measured, and methods of data collection vary across studies. The choice of a well-validated model for bone tissue regeneration engineering research remains a difficult task. Additional research is the need of the hour for determining safer and efficient bone tissue engineering strategies for potential clinical applications.

References

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Makoto Tsuchimochi*
Editor-in-Subchief, Japanese Dental Science Review
Professor and Chairman, Department of Oral and Maxillofacial Radiology, The Nippon Dental University School of Life Dentistry at Niigata, Niigata, Japan

*Tel.: +81 25 267 1500; fax: +81 25 233 0307
E-mail address: tsuchimochi@ngt.ndu.ac.jp